REMARKS

Claims 13, 16-18, 20-23, 25, 26, 29-35 and 37-43 are currently pending in this application. Claims 13 and 16 have been amended and claim 19 has been cancelled. No new matter has been added to this application.

Rejection of Claims 13, 16-18, 20-22, 42 and 43 under 35 U.S.C. § 112

The Examiner has rejected claims 13, 16-18, 20-22, 42 and 43 under 35 U.S.C. § 112, second paragraph, as being indefinite. Applicants respectfully traverse the rejection.

Applicants have amended claims 13 and 16 to remove any references to "it" and have canceled claim 19. Claims 17, 18, 20-22, 42 and 43 being dependent upon independent claim 16 are believed to be definite. Applicants respectfully submit that claims 13 and 16, as amended, correct any prior indefiniteness and request that the rejection of the claims under 35 U.S.C. § 112, second paragraph be withdrawn.

Rejection of Claims 13, 16-18, 22, 23, 31-35, 37 and 40-42 under 35 U.S.C. § 103(a)

The Examiner has rejected claims 13, 16-18, 22, 23, 31-35, 37 and 40-42 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication No. 2002/077540 (Kienzle) in view of Frank Sauer et al., "Augmented Workspace: designing an AR testbed" (Sauer). The Examiner contends that Kienzle discloses a method for augmented reality guided instrument positioning. The Examiner correctly notes that Kienzle does not teach or disclose rendering at least one graphics path guide on a display overlaid onto a direct optical or video view that contains the real instrument and a real object, which includes the entry point. The Examiner contends that Sauer teaches a video see through HUD and superimposing graphics guides onto the video of the real instrument and the real object. The Examiner argues that it would have been obvious to one of ordinary

skill in the art to display the rendered graphics path guide on Kienzle's display overlaid onto a direct optical or video view that contains the real instrument and the real object. Applicants respectfully traverse the rejection.

Applicants' application currently recites three claim sets, each directed to a different embodiment of the present invention. Claim 13 is directed to a method for augmented reality guided instrument positioning in which at least one graphics path guide is rendered for indicating a path for a real instrument to follow to a target located inside or on the surface of a real object. The graphics path guide is constructed in a way that the frame guide frames the path at least outside of the real object so as not to obstruct a view of a central part of the real instrument along the real instrument's axis as viewed from the side if the real instrument is in correct alignment to the path. The rendered at least one graphics path guide is displayed on a display overlaid onto a direct optical or video view that comprises a real view of the real instrument and the real object. A user moves the real instrument, observed in the real video view, to align the real instrument with the at least one graphics path guide. The display shows the at least one graphics guide overlaid onto the view of the real instrument and the real object. The real instrument is aligned with the path by determining when the at least one graphics path guide frames the path so that a view of a central part of the real instrument is not obstructed by the at least one graphics path guide. The real instrument is moved along the path so that a front portion of the real instrument is inserted into the object until the real instrument's tip reaches the target, and concurrently monitoring the correct alignment between the visible part of the real instrument outside of the real object and the framing path guide.

Claims 16-18, 20-22, 42 and 43 are directed to a method for augmented reality guided instrument positioning in which a bulls eye graphics path guide is used to align an instrument with an entry point on a real object corresponding to a target. A target point is defined within an real object. A path is defined to reach the target point with a real instrument. A graphical

representation is rendered to mark the path in the form of at least one graphical axis marker to be viewed in the direction of the path towards the target on a display overlaid onto a direct optical or video view of a real scene that comprises the real instrument, and the real object, so that a user can perceive the real instrument and the at least one graphical axis marker and their spatial relationship in an augmented reality view. A user's augmented reality line-of-sight is aligned with the at least one graphical axis marker so that the path to reach the target point with the real instrument is aligned along the augmented reality line-of-sight. The real instrument is aligned to the path by aligning the real instrument with the augmented reality line-of-sight towards the target point. The real instrument is moved along the path towards the actual target point while keeping the real instrument aligned with the augmented reality line-of-sight.

Claims 23, 25, 26, 29-35 and 37-41 are directed to a method for virtual reality guided instrument positioning. A target is defined on a real object. A path to reach the real object is defined. A pose of a real instrument with respect to a pose of the real object is tracked. A graphical representation of the real instrument and the path is rendered to obtain a virtual instrument and a graphical virtual guide on a display. . The graphical representation is rendered with respect to a virtual viewpoint from which a virtual line of sight coincides with a virtual path for the virtual instrument to follow during a positioning of the real instrument to the target point. The virtual guide corresponds to the path. The virtual instrument comprises a 3D structure for line of sight alignment. The 3D structure comprises a plurality of markers centered on and distributed along an axis of the virtual instrument;

The virtual instrument is aligned along the virtual line of sight according to the virtual guide in order to accordingly align the real instrument along the path. The real instrument is moved by a user in response to viewing the virtual instrument and the virtual guide on the display. The real instrument moves along the path towards the real target point keeping the correct alignment by observing

and keeping in alignment with the virtual instrument and virtual guide. The user needs to keep the alignment intact while inserting the real instrument into the real object toward the target point. Claim 23 introduces tracking of the real instrument. In this case, position and orientation of the real instrument with respect to the real object and the path are known, and the user does not need an augmented reality view that comprises a view of the real instrument to perform correct alignment. Alignment can now be performed based on a graphical virtual representation of both instrument and path.

Kienzle discloses a computer assisted surgery system which uses graphic representations that are displayed overlaid onto X-ray images. Kienzle discloses a standard navigation system in which the location of the tracked instrument is superimposed as a virtual model onto a medical image. Correct alignment is achieved by looking at the position of the instrument's virtual model in the medical image. In Kienzle, using a tracking system to track the position of the actual instrument is an essential part of the navigation process.

In the present invention, there is no need to track the actual instrument (except claim 23, which uses tracking in combination with the specific line-of-sight method). A user sees a real view of the real instrument and a real patient. These real images are augmented with graphical information that allows the user to perceive planned paths for instrument guidance. Correct alignment is performed by looking at the augmented reality image and seeing the position of the real instrument in relation to the graphical guides. Applicants respectfully submit that Kienzle does not teach using augmented reality for guided instrument positioning. Kienzle merely teaches using a virtual feature to identify landmark points in the body of a patient. Applicants' method uses a graphical guide to align with an entry point, which in turn is lined up with a target. However, unlike Kienzle, Applicants do not use markers or any type of imaging to see points within the body. Applicants' method is performed using a real world perspective;

the user does not see images within the body. As such, Kienzle does not teach or disclose Applicants' invention as claimed.

The Sauer article shows the work that was done prior to Applicants' invention. Sauer shows using augmented reality to guide a needle in which a "virtual cylinder indicates the correct needle path in 3D". However, Sauer does not teach or disclose using a frame to guide the path as disclosed in claim 13 in which part of the needle is exposed. Sauer uses a cylinder which completely obstructs the vision of the needle during alignment. It has been found that this can cause improper placement of the needle because it is not clear when the needle is obstructed if alignment has been reached or if the needle is in the incorrect orientation. The frame serves the dual purpose of guiding the needle while allowing the user to confirm the proper alignment of the needle.

Likewise, Sauer does not teach or disclose using a bull's eye approach to guide the needle to an entry point to a target. In Figure 7, the user is viewing the cylinder lengthwise and trying to align the needle with the cylinder. Sauer is not using the cylinder in a bull's eye fashion as is recited in independent claims 16 and 23. Applicants respectfully submit, that Sauer does not teach or disclose Applicants' invention as claimed.

Applicants respectfully submit that the combination of Kienzle and Sauer do not teach or disclose Applicants' invention as claimed. Neither Kienzle nor Sauer, whether taken alone or in combination, teach or disclose a graphics guide which frames the path of an instrument to an entry point corresponding to a target. Nor do Kienzle or Sauer teach or disclose a graphics line-of-sight guide which guides an instrument to an entry point corresponding to a target. Applicants request that the rejection of claims 13, 16-18, 22, 23, 31-35, 37 and 40-42 under 35 U.S.C. § 103(a) be withdrawn.

Rejection of Claim 20, 21, 25, 26, 29, 30, 38, 39 and 43 under 35 U.S.C. § 103(a)

The Examiner has rejected claims 20, 21, 25, 26, 29, 30, 38, 39 and 43 under 35 U.S.C. § 103(a) as being unpatentable over Kienzle in view of the Sauer article and in view of Applicants' admitted prior art. The Examiner correctly notes that Kienzle does not teach or disclose a graphical axis marker that comprises an intersection of at least two lines that is centered on the axis of the actual instrument for correct alignment. Nor does Kienzle teach rendering by using a virtual camera with a wide angle lens. The Examiner contends that Sauer teaches uses gun aiming and argues that it would have been obvious to one skilled in the art to apply it to augmented reality aiming of real instruments and using a virtual camera with a wide angle lens. Applicants respectfully traverse the rejection.

Applicants respectfully submit that the combination of Kienzle, Sauer and the prior art cited by Applicants does not teach or disclose Applicants' invention as claimed. Neither Kienzle nor Sauer nor the prior art teach or disclose an augmented reality method for positioning an instrument in which the steps of "aligning the user's augmented reality line-of-sight with the at least one graphical axis marker so that the path to reach said entry point with the real instrument is aligned along the augmented reality line-of-sight" and "aligning the real instrument to the path by aligning the real instrument with the augmented reality line-of-sight towards the entry point;" as recited in amended independent claim 16. Claims 20 and 21 being dependent upon independent claim 16 are also not taught or disclosed by the combination of Kienzle, Sauer and the prior art. Likewise, neither Kienzle, Sauer or the prior art teach or disclose "aligning the virtual instrument along the virtual line of sight according to the graphical virtual guide in order to accordingly align the real instrument along the path" and "moving the real instrument by a user in response to viewing the virtual instrument and said graphical virtual guide on the display, the real instrument

moving along the path towards the real entry point keeping the correct alignment by observing and keeping in alignment with the virtual instrument and graphical virtual guide" as recited in independent claim 23. Claims 25, 26, 29, 30, 38, 39 and 43 being dependent upon independent claim 23 are also not taught or disclosed by the combination of Kienzle, Sauer and the prior art. Applicants respectfully request that the rejection of claim 20, 21, 25, 26, 29, 30, 38, 39 and 43 under 35 U.S.C. § 103(a) be withdrawn.

Conclusion

Applicants respectfully submit that claims 13, 16-18, 20-23, 25, 26, 29-35 and 37-43, as amended, are in condition for allowance and request that a timely Notice of Allowance be issued in this case. The Examiner is invited to contact the undersigned should he have any questions in this matter.

Respectfully submitted,

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